Functionality of the Brain with respect to the Neurophilosophical Schemes Theory

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Abstract

Presented is a new neurophilosophic monistic theory describing the activity of the human brain and providing explanations for its different cognitive functions. The theory suggests the existence of a cognitive brain cycle, along which Cognitive Brain Processing Units (CBPUs) are situated. The CBPUs carry out several processing operations on an interacting flux of electrically-converted information units called 'Schemes'. According to the theory, during the evolution of the human brain, a new cognitive processing unit has been emerged albeit retaining the formerly existing (animalistic) physiological brain activity. The direct consequence of this event is the occurrence of a dually processing brain system in modern humans. The theory further predicts the evolutional appearance of a special CBPU (imagination), whose role is in utilizing the bidirectional scheme flow to create alternative scenarios that enlarge the assortment of possibilities from which a decision can be made.

Keywords:
Memory, Information, Perception, Evaluations, Conclusions, Awareness.

Introduction

During the last several decades, intensive efforts have been made worldwide to study and explain the human cognitive functions. Despite the progress, there is still no single theory, which can provide a global explanation for the complex operational framework of the brain. This work presents the *Neurophilosophical Schemes Theory (NST).* A novel approach which is based upon neurological causes. The theory hypothesizes and discusses the theoretical rules of operation, used in the human brain to control the entire spectrum of cognitive functions.

It is well known that brain activity is facilitated by generation of electrical pulses at the neurons. The NST defines these pulses as *schemes* - converted products of information which are being constantly generated by different *processing brain units (PBUs)* at various regions of the brain (Allport, 1980). Depending on the active PBU, several neurological parameters are established, including the electrical pulse's duration, frequency and amplitude.

The NST assumes that the PBUs are situated along a pathway referred to as the *cognitive-cycle*, where schemes are flowing according to a specific directionality. The flow of schemes towards the memory is defined as a *bottom-up flow* whereas the flow from the memory towards the PBUs is defined as a *top-down flow*. The schemes are therefore the product of converting information into electrical currents. They both include presently processed information, as well as previous encodings from earlier-stage processing operations performed by the PBUs with respect to this information. In this view, schemes may also be treated as 'words' that assemble the global 'brain language'. It should be emphasized that this 'brain language' is not the verbal human language. Indeed, if we were able to decode it, we might obtain a better understanding of the brain functionality including an insight to the cognitive operational rules which

are both dictated and controlled by the different PBUs. The NST provides a theoretical model for describing the brain functions, without the preliminary need to decrypt the 'brain language'. The NST assumes the existence of a latent cognitive PBU, called the *awareness unit*, whose role is to 'back-translate' the information associated with fluxes of crossing schemes, into the corresponding output of thoughts in human understandable language. The NST, therefore, utilizes the human cognitive function of *awareness*, revealed by the acts of *thinking* and *speaking*, in regard with the processing operations taken place at the PBUs along the cognitive cycle, to explore the rules of the 'brain-language'.

The NST further suggests that whereas all of the cognitive functions are produced by the PBUs according to the same common generation rules, each of them eventually supports its own specific functional role. Based on a series of assumptions regarding the processing of the schemes at the different PBUs, coupled and confronted with the understandable information obtained by the awareness unit, the NST is enabled to predict the following: (i) what types of PBUs coexist along the cognitive-cycle to carry out the entire spectrum of human cognitive functions; (ii) which processes indeed occur at these units; and, (iii) to which direction are the schemes flowing.

The NST predictions are in agreement with nowadays analyses made by imaging methods such as fMRI. Such techniques are employed to examine the response of localized brain regions during physiological or mental stimuli (Casebeer, 2003) in attempt to find correlation between specific brain units and the implementation of different cognitive functions (from which *cognitive processing brain units - CPBUs* may be discovered). At this point, it should be noted that a single

CPBU is not necessarily a separate, independent physiological entity, but can also comprise several physiological brain segments.

Results and Discussion

2.1 The Dual Functionality Hypothesis

A key argument in the NST, which is a monistic theory, is that due to evolution the human brain conducts, to a certain stage, two different, parallel, information processing cycles (courses). The first course is the *physiological course*, which both exists in humans as well as in other living creatures. Here, instinctive measures reflecting memories from previous rewarded acts, solely dictate a range of priorities for executing brain conclusions that instinctively control the individual's preferred behavior. The second, *cognitive course*, initiates the information processing only after the schemes have been produced by the *perception unit*. The outcome of the CPBUs is reflected by the top-down flowing associative information, revealed from the *long-term memory (LTM)*, (Ericsson et al., 1995).

Activity in both courses begins with sensing external information perceived by the *senses* or internal information, perceived as *sensations*. The information associated with these two separated sources is perceived in parallel and reaches the perception unit, where it is encoded (namely, processed, integrated and transformed) into schemes. Each individual course (physiological or cognitive), may be regarded as a separate, independent, *information processing unit*. Requirements from such a unit include: (i) the ability to store information efficiently; (ii) a large storage capacity; (iii) information-processing resources, and (iv) the ability to access and utilize the stored information on demand (recalling).

The NST predicts the existence of a two separate memories – a *physiological memory* and a *long term informative memory* (LTM), respectively corresponding to the physiological and cognitive courses. The physiological memory is mainly an entity that stores genetic values regarding physical and physiological conditions such as: survival, reproduction and interpersonal relationships. The real-time values of the active brain substances are constantly compared to the values genetically stored at the physiological memory. Both the nature and the extent of instinctive human physiological responses (*motivation*) are attributed to deviations from the physiological memory's stored values. We become aware of this phenomenon through our *needs*. Unlike the physiological memory, the LTM serves the cognitive course by storing perceived facts and values within seven different intelligences: *implementation, spatial, mathematical,* the *'self',* the *'others', musical and lingual* facts. Here too, human responses are governed by the extent of deviation of different verities in comparison to facts stored at the LTM. We become aware of these responses through our *wills*.

According to the dual functionality hypothesis, the schemes are simultaneously but separately evaluated by two different PBUs called the *physiological evaluation unit* and the *cognitive evaluation* unit. Latent evaluations are being constantly generated (Christoff et al., 2003) and encoded on the schemes. We become aware of the *physiological evaluations* by a reflection of a physical act (when the intensity of the evaluation exceeds a certain threshold), called *feelings*. On the other hand, awareness to the cognitive evaluations is facilitated through reflections of physical acts expressed as *emotions*. Those two separated evaluations, are joined and combined (through *binding*) by a PBU called the *combined evaluation unit*. Upon a successful combination, the schemes are further transferred to another PBU - the

conclusions unit, whose role is in generating a clear, single and definite conclusion or decision. Should a *combined evaluation* not be obtained, a perturbation to the schemes-processing operation will occur. According to the NST this situation represents a state in which a conflict between two different evaluations prevents their combination and is therefore the key to understand the cognitive discipline called *psychology*.

The internal processing failure, promotes a state of indecision which is expressed by the feeling of *disappointment*. In order to overcome this failure, repetitive, instinctive attempts to produce a decent combined evaluation are being intensively performed. When none of these efforts succeeds, the brain faces two choices. The first is to use a cognitively-governed bypass mechanism in which the cognitive evaluation is discarded and the combined evaluation is solely based on the physiological evaluation. We refer to this solution as *intuition* (leading in many cases to good decisions). The second alternative is to produce compensating brain substances, which is often used when the conflict is not resolved over a considerable period of time. In many cases the situation becomes intensified by the repetitive, exhaustive efforts to resolve the problem and by the urge to change the state of indecision. Upon an increase in the concentration levels of the active brain materials, a change which is accompanied by the feeling of an *internal stress* occurs. Following a prolonged duration of an unsolved problem, the production of brain materials exceeds a certain threshold and the individual is prone to develop a state which is accompanied by feelings of *depression*. Depression is therefore a condition where anomalous levels of brain active substances (exceeding the concentration levels required by the genetic physiological memory) are deliberately produced to prevent the emergence of indecision. In the majority of the cases, these changes stimulate

physiological reactions that deepen the state of depression. Moreover, depression brings a lot of suffering that is not observed physically. In some cases these interior changes are responsible for creating external physiological symptoms. Such symptoms, for more severe cases, have been diagnosed in the past as *mental illnesses*.

The dual functionality terminates, where both the physiological and cognitive evaluations are synchronized to a single solid combined evaluation. Subsequent conclusions and decisions are produced at the *conclusions processing unit*, the last point shared by both the courses and their point of segregation. The decisions made in this unit, constitute the ground for a balanced, normative human behavior. The decisions direct the schemes in the physiological course to the *implementation unit* where they are executed. Decisions made for the schemes at the cognitive course are primarily considering alternative-arguments, produced and provided by the imagination unit. In the following stage, they are directed towards the LTM for encoding and deposition.

The other CPBUs are mainly operating at the top-down side of the cognitive course. These include: the *inhibition unit, imagination unit* and *awareness unit*. The inhibition unit (Markram et al., 2004) uses a stream of *scheme-copies*, retrieved from the LTM, to carry associative memories which are used, upon recognition of a potential hazard, to abort operational decisions before they are being implemented. The imagination unit uses the scheme-copies to generate alternative conclusions to those produced during the ordinary bottom-up scheme flow. The awareness unit's functionality is in back-translating information carried by the top-down flowing scheme-copies, into an understandable language, thus creating awareness to internal thoughts (Haynes et al., 2006).

The constant top-down stream of the schemes-copies represents the entire subjective knowledge of the individual human being and can be regarded as his *consciousness* (Rees et al., 2002). During the top-down stream, the schemes-copies loose some of their internal energy and below a certain energy threshold they are 'grounded' and removed from the system. Only scheme-copies supporting sufficiently high intensity, may reach the *concentration-regulator* which redirects them into the bottom-up side of the cognitive-cycle. Upon the arrival of those special schemes to the evaluation unit they become reevaluated - an act which is accompanied by a unique, characteristic feeling which we call *experience*. It should be noted that up until now, the generation mechanism of this latent feeling (experience) was beyond a scientific explanation. It was defined as the 'hard' problem of consciousness (Chalmers, 1995) and has been generally considered as a phenomenal act which is concerned with consciousness (this connection is also supported by the NST). It should be emphasized, however, that all the postulations supported here are based on pure logics and hence negate phenomenalism.

The monistic NST postulates that the following stages appeared in the evolution of the human brain: (i) creation of the LTM; (ii) creation of the cognitive cycle; (iii) the use of a quantum process (Engel et al., 2007), allowing the deposition and retrieval of information to and from the LTM; (iv) appearance of physiological processing units; (v) generation of cognitive functions due to interaction between the bidirectional flow of information, that is the bottom-up versus the top-down flowing schemes (Siegel et al., 2000). From a metaphoric point of view, the brain is capable of generating cognition, using a 'biological hardware' (which are the brain cells) and an ever-changing 'software' which refers to the interactions between the bidirectionally flowing schemes.

2.2 Imagination, Creativity, Abstract Thinking and Moral Thinking.

According to the NST model, the functional products (output) of the imagination unit are the imagination schemes. They provide cognitive alternatives to the conclusions produced by the bottom-up flowing schemes. The imagination schemes flow top-down towards the conclusion and the awareness units and further towards the concentration-regulator. The regulator inverts their direction to a bottom-up flow in the cognitive course, on their way to being finally deposited at the LTM. The deposition of imagination schemes at the *implementation intelligence* of the memory produces top-down flow of relevant scheme-copies, which facilitate the operation of the implementation unit. We call this specific cognitive activity - *creativity*.

The NST predicts the existence of a cognitively controlled abridged course through which the imagination schemes flow. The deposition of the imagination schemes at the LTM is followed by the retrieval of information relevant to the original imagination by the use of *imagination scheme-copies*. The imagination scheme-copies return to the imagination unit and regenerate newer imagination schemes and so forth and so on. Upon an increased number of such cyclic iterations, a situation may occur in which the thoughts of the human might become drawn away from reality. This is the ground for the cognitive function known as *abstract thinking*. Furthermore, the use of this imagination abridged cycle, to evaluate the thoughts and deeds of another person, explains the existence of *moral thinking* (Moll et al., 2005) and altruism (Brunero, 2002). It should be noted that the lack of imaginative and abstract thinking in animals, clearly indicate the absence of an imagination unit from their brain.

Conclusions

The NST presents a structure model of the brain activity, in which a simultaneous, parallel, top-down flow of schemes from seven sections (intelligences) of the LTM, occurs. This structure enables the thinking and the processing of information to be carried out within a remarkably short timescale. It includes the ability to think about present events, to compare them with the past and to generate imaginative thoughts concerning the future. The physiological changes needed for the transitions between the different modes of thinking and processing, are so fast, common and routine, that they require no awareness from the individual.

The NST model presented in this article is a monistic neurophilosophical theory that hypothesizes and explains the principal operating rules according to which the brain is acting, including the behavior of the entire human cognitive functioning.

References

Allport, D. A. (1980). Patterns and actions: Cognitive mechanisms are content-specific. In G. Claxton, (Ed.), *Cognitive Psychology: New directions*, pp. 184-216. London: Routledge & Kegan Paul.

Brunero, J. (2002). Evolution, altruism and internal reward explanations. *Philosophical Forum*, *33*, 413-424.

Casebeer, W. D. (2003). Moral cognition and its neural constituents. *Nature Reviews Neurosci*ence, *4*, 840-846.

Chalmers, D. (1995). Facing up to the problem of consciousness. *Journal of Consciousness Studies*, *2*, 200-219.

Christoff, K., Ream, J. M., Geddes, L. P. & Gabrieli. J. D. (2003). Evaluating self-generated information: Anterior prefrontal contributions to human cognition. *Behavioral Neuroscience,* 117, 1161–1168.

Engel, G.S., Calhoun, T. R., Read, E. L., Ahn, T-K., Mancal, T., Cheng, Y-C., Blankenship, R. E., & Fleming G. R. (2007). Evidence for wavelike energy transfer through quantum coherence in photosynthetic systems. *Nature*, *446*, 782-786.

Ericsson, K. A. & Kintsch, W. (1995). Long-term working memory. *Psychological Review*, *102*, 211-245.

Haynes, J., & Rees, G. (2006). Decoding mental states from brain activity in humans. *Nature Reviews Neuroscience*, *7*, 523-534.

Markram, H., Toledo-Rodriguez, M., Wang, Y., Gupta, A., Silberberg, G., & Wu, C. (2004). Interneurons of the neocortical inhibitory system. *Nature Reviews Neuroscience*, *5*, 793-807.

Moll, J., Zahn, R., De Oliveira-Souza, R., Krueger, F., & Grafman, J. (2005). Opinion: The neural basis of human moral cognition. *Nature Reviews Neuroscience*, *6*, 799-809.

Rees, G., Kreiman, G., & Koch, C. (2002). Neural correlates of consciousness in humans. *Nature Reviews Neuroscience, 4*, 261-270.

Siegel, M., Körding, K. P., & König, P. (2000). Integrating top-down and bottom-up sensory processing by somato-dendritic interactions. *Journal of Computational Neuroscience, 8*, 161-173.

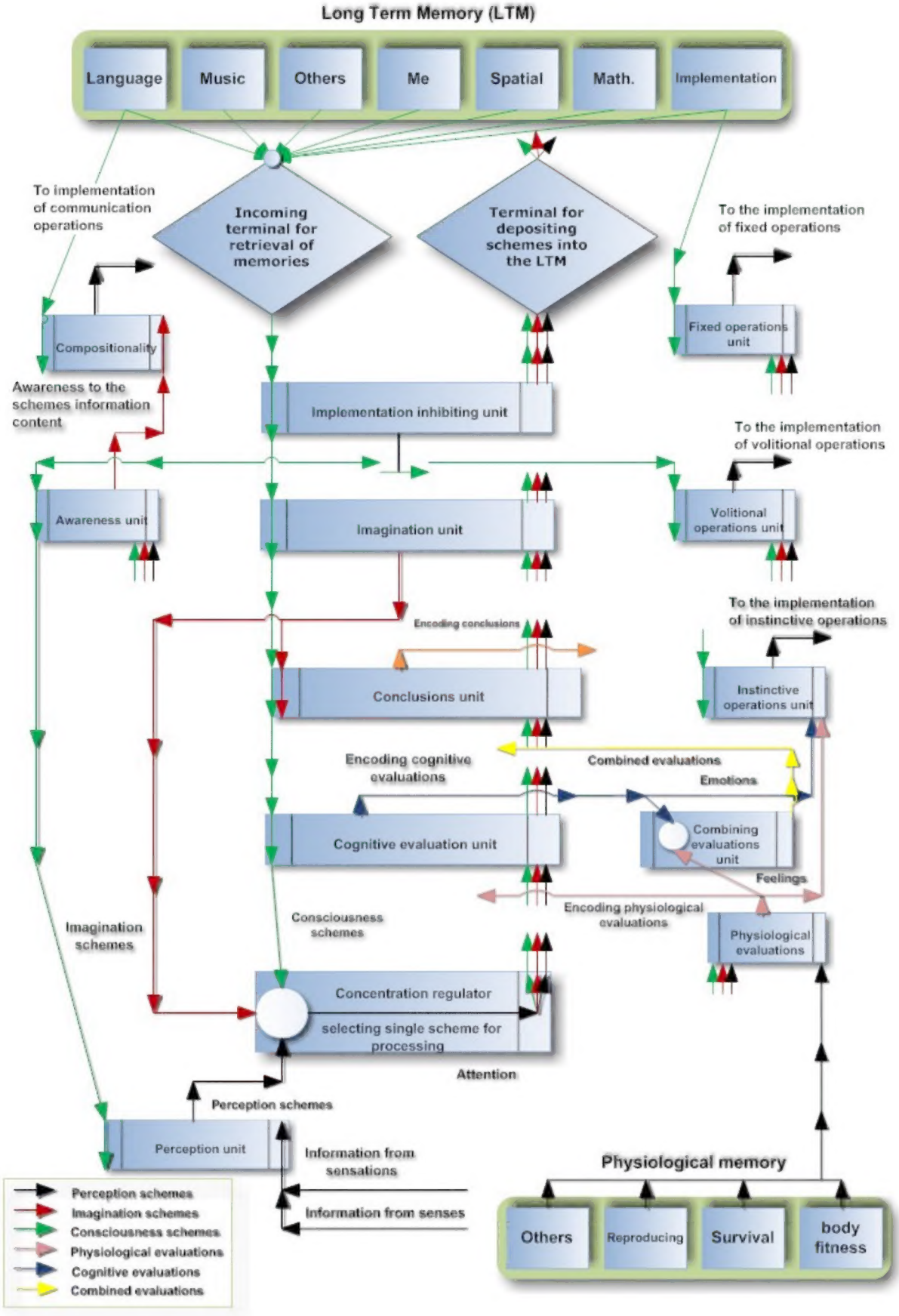

Figure 1: The combined cognitive and physiological system according to the NST.